An Improved System for the Palladium-Catalyzed Borylation of Aryl Halides with Pinacol Borane

Kelvin Billingsley and Stephen L. Buchwald*

Department of Chemistry, Massachusetts Institute of Technology, Cambridge, MA 02139

Experimental Section

General Considerations. All reactions were stirred with the aid of a magnetic stirrer and carried out under an argon atmosphere. 1,4-Dioxane (anhydrous), triethylamine (≥99.5%) and pinacol borane (97%) were purchased from Aldrich Chemical Co. in SureSeal® bottles. Commercially available materials were used without further purification unless otherwise noted. SPhos (**1**) and aryl halides were purchased from Aldrich Chemical Co. Liquid aryl halides were purified by passage through a pad of basic alumina prior to use. $PdCl_2(CH_3CN)_2$ was purchased from Strem Chemicals, Inc. and stored in a benchtop desiccator.

All new compounds were characterized by ^{1}H NMR, ^{13}C NMR, IR spectroscopy, melting points (for solids) and, in some cases, elemental analysis. Known compounds were characterized by ^{1}H NMR, ^{13}C NMR and melting points (for solids) and compared to their literature values. ^{1}H and ^{13}C NMR spectra were recorded on a Varian Mercury 300. Infrared spectra were recorded on an ASI Applied Systems ReactIR 1000 (neat samples were placed directly on the DiComp probe). Elemental analyses were preformed by Atlantic Microlabs Inc., Norcross, GA. All ^{1}H NMR experiments are reported in δ units, parts per million (ppm) downfield of TMS and were measured relative to the signals for the residual benzene (7.16 ppm), chloroform (7.26 ppm), dimethylsulfoxide

(2.50 ppm) or methanol (3.31 ppm). All ^{13}C NMR spectra were reported in ppm relative to residual chloroform (77 ppm), dimethylsulfoxide (39.5 ppm) or methanol (49 ppm) and were obtained with ^{1}H decoupling. Melting points were obtained on a Mel-Temp capillary melting point apparatus and are uncorrected. Gas chromatographic analyses were performed on Hewlett-Packard 6890 gas chromatography instrument with a FID detector using 25 m x 0.20 mm capillary column with cross-linked methyl siloxane as a stationary phase.

The yields in table 2 refer to isolated yields (average of two runs) of compounds estimated to be ≥ 95% pure as determined by ^{1}H NMR and GC analysis and/or combustion analysis.

I. Experimental for the Borylation of Aryl Halides.

General Procedure A: Pd-Catalyzed Borylation of Aryl Iodides and Bromides.

An oven-dried resealable Schlenk tube possessing a Teflon screw valve was charged with $PdCl_2(CH_3CN)_2$ (0.25%-2.0%) and SPhos (1.0-8.0%). The Schlenk tube was capped with a rubber septum and then evacuated and backfilled with argon (this sequence was carried out a total of two times). 1,4-Dioxane (0.30 mL) was added via syringe, through the septum, followed by the addition of the aryl halide (0.50 mmol), NEt_3 (0.209 mL, 152 mg, 1.50 mmol) and pinacol borane (0.109 mL, 96.1 mg, 0.75 mmol) in a like manner (aryl halides that were solids were added with the other solid reagents). The septum was then replaced with a Teflon screw valve and the Schlenk tube was sealed. The reaction mixture was heated to 110 °C *(These reactions are conducted in a sealed tube at a temperature higher than the boiling point of 1,4-dioxane and NEt_3. For larger scale reactions, the appropriate safety precautions should be undertaken including the use of a blast shield)* until the aryl halide had been completely consumed as determined by gas chromatography and the reaction mixture was then allowed to cool to room temperature. The reaction solution was filtered through a thin pad of celite (eluting with ethyl acetate) and the eluent was concentrated under reduced pressure. The crude material so obtained was purified via flash chromatography on silica gel.

General Procedure B: Pd-Catalyzed Borylation of Aryl Chlorides.

An oven-dried resealable Schlenk tube possessing a Teflon screw valve was charged with $PdCl_2(CH_3CN)_2$ (3.0-4.0%) and SPhos (12.0-16.0%). The Schlenk tube was capped with a rubber septum and then evacuated and backfilled with argon (this sequence was carried out a total of two times). NEt_3 (0.500 mL) was added via syringe, through the septum, followed by the addition of the aryl chloride (0.50 mmol) and pinacol borane (0.109 mL, 96.1 mg, 0.75 mmol) in a like manner (aryl halides that were solids were added with the other solid reagents). The septum was then replaced with a Teflon screw valve and the Schlenk tube was sealed. The reaction mixture was heated to 110 °C *(These reactions are conducted in a sealed tube at a temperature higher than the boiling point of 1,4-dioxane and NEt_3. For larger scale reactions, the appropriate safety precautions should be undertaken (i.e. the use of a blast shield))* until the aryl halide had been completely consumed as determined by gas chromatography and was then allowed to cool to room temperature. The reaction solution was filtered through a thin pad of celite (eluting with ethyl acetate) and the eluent was concentrated under reduced pressure. The crude material so obtained was purified via flash chromatography on silica gel.

2-(4-methoxyphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 1).[1] Following general procedure A, a mixture of 4-iodoanisole (127 mg, 0.50 mmol), pinacol borane, NEt_3, $PdCl_2(CH_3CN)_2$ (1.3 mg, 0.0050 mmol) and SPhos (8.2 mg, 0.020 mmol) was heated in 1,4-dioxane for 30 min. Flash column chromatography (5% EtOAc/Hexanes) yielded the title compound in 110 mg (94% yield) as a colorless oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.75 (d, J = 9 Hz, 2H), 6.90 (d, J = 9 Hz, 2H), 3.83 (s, 3H), 1.34 (s, 12H). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 162.1, 136.4, 113.2, 102.7, 83.4, 55.0, 24.8. ^{1}H NMR spectrum included.

2-(4-methoxyphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 2).[1] Following general procedure A on a larger scale, a mixture of 4-iodoanisole (234 mg, 1.00 mmol), pinacol borane (0.218 mL, 192 mg, 1.50 mmol), NEt_3 (0.418 mL, 354 mg, 3.00 mmol), $PdCl_2(CH_3CN)_2$ (0.26 mg, 0.0010 mmol) and SPhos (1.6 mg, 0.0040 mmol) was heated in 1,4-dioxane for 30 min. Flash column chromatography (5% EtOAc/Hexanes) yielded the title compound in 212 mg (91 % yield) as a colorless oil.

[1] Zhu, W.; Ma, D. *Org. Lett.* **2006**, *8*, 261.

^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.75 (d, J = 9 Hz, 2H), 6.90 (d, J = 9 Hz, 2H), 3.83 (s, 3H), 1.34 (s, 12H). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 162.1, 136.4, 113.2, 102.7, 83.4, 55.0, 24.8. ^{1}H NMR spectrum included.

2-(4-methoxyphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 3).[1] Following general procedure A, a mixture of 4-bromoanisole (62.5 μL, 93.5 mg, 0.50 mmol), pinacol borane, NEt_3, $PdCl_2(CH_3CN)_2$ (1.3 mg, 0.0050 mmol) and SPhos (8.2 mg, 0.020 mmol) was heated in 1,4-dioxane for 1 h. Flash column chromatography (5% EtOAc/Hexanes) yielded the title compound in 113 mg (97% yield) as a colorless oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.75 (d, J = 9 Hz, 2H), 6.90 (d, J = 9 Hz, 2H), 3.83 (s, 3H), 1.34 (s, 12H). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 162.1, 136.4, 113.2, 102.7, 83.4, 55.0, 24.8. ^{1}H NMR spectrum included.

2-(4-methoxyphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 4).[1] Following general procedure B, a mixture of 4-chloroanisole (61.2 μL, 71.3 mg, 0.50 mmol), pinacol borane, NEt_3 (0.500 mL), $PdCl_2(CH_3CN)_2$ (3.9 mg, 0.015 mmol) and SPhos (24.6 mg, 0.060 mmol) was heated for 24 h. Flash column chromatography (5% EtOAc/Hexanes) yielded the title compound in 112 mg (96% yield) as a colorless oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.75 (d, J = 9 Hz, 2H), 6.90 (d, J = 9 Hz, 2H), 3.83 (s, 3H), 1.34 (s, 12H). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 162.1, 136.4, 113.2, 102.7, 83.4, 55.0, 24.8. ^{1}H NMR spectrum included.

***N*,*N*-dimethyl-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)aniline (Table 1, Entry 5).**[2] Following general procedure A, a mixture of 4-bromo-*N,N*-dimethylaniline (100.0 mg, 0.50 mmol), pinacol borane, NEt_3, $PdCl_2(CH_3CN)_2$ (1.3 mg, 0.0050 mmol) and SPhos (8.2 mg, 0.020 mmol) was heated in 1,4-dioxane for 3 h. Recrystallization (Hexanes) yielded the title compound in 105 mg (85% yield) as a white solid, mp 116-117 °C. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.71 (d, J = 8 Hz, 2H), 6.70 (d, J = 8 Hz, 2H), 3.00 (s, 6H), 1.34 (s, 12H). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 152.5, 136.1, 111.2, 83.1, 40.1, 24.8 (No C-B Signal). ^{1}H NMR spectrum included.

[2] Broutin, P.-E.; Cerna, I.; Campaniello, M.; Leroux, F.; Colobert, F. *Org. Lett.* **2004**, *6*, 4419.

2-(4-butylphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 6).[3] Following general procedure A, a mixture of 4-bromo-*n*-butylbenzene (106.5 mg, 0.50 mmol), pinacol borane, NEt_3, $PdCl_2(CH_3CN)_2$ (1.3 mg, 0.0050 mmol) and SPhos (8.2 mg, 0.020 mmol) was heated in 1,4-dioxane for 4 h. Flash column chromatography (2.5% EtOAc/Hexanes) yielded the title compound in 109 mg (84% yield) as a colorless oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.75 (d, J = 8 Hz, 2H), 7.22 (d, J = 8 Hz, 2H), 2.64 (t, J = 8 Hz, 2H), 1.62 (p, J = 8 Hz, 2H), 1.37 (sex, J = 8 Hz, 2H), 1.36 (s, 12H), 0.94 (t, J = 8 Hz, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 146.3, 134.8, 127.9, 83.5, 35.8, 33.5, 24.8, 22.3, 13.9 (No C-B Signal). ^{1}H NMR spectrum included.

2-(4-butylphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 7).[3] Following general procedure B, a mixture of 4-*n*-butylchlorobenzene (82.0 μL, 84.4 mg, 0.50 mmol), pinacol borane, NEt_3 (0.50 mL), $PdCl_2(CH_3CN)_2$ (3.9 mg, 0.015 mmol) and SPhos (24.6 mg, 0.060 mmol) was heated in 1,4-dioxane for 24 h. Flash column chromatography (2.5% EtOAc/Hexanes) yielded the title compound in 81 mg (62% yield) as a colorless oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.75 (d, J = 8 Hz, 2H), 7.22 (d, J = 8 Hz, 2H), 2.64 (t, J = 8 Hz, 2H), 1.62 (p, J = 8 Hz, 2H), 1.37 (sex, J = 8 Hz, 2H), 1.36 (s, 12H), 0.94 (t, J = 8 Hz, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 146.3, 134.8, 127.9, 83.5, 35.8, 33.5, 24.8, 22.3, 13.9 (No C-B Signal). ^{1}H NMR spectrum included.

phenyl(4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)phenyl)methanone (Table 1, Entry 8).[4] Following general procedure A, a mixture of 4-bromobenzophenone (130 mg, 0.50 mmol), pinacol borane, NEt_3, $PdCl_2(CH_3CN)_2$ (1.3 mg, 0.0050 mmol) and SPhos (8.2 mg, 0.020 mmol) was heated in 1,4-dioxane for 5 h. Flash column chromatography (10% EtOAc/Hexanes) yielded the title compound in 108 mg (70% yield) as a yellow solid, mp 96-97 °C. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.91 (d, J = 8 Hz, 2H), 7.79 (dd, J = 1,8 Hz, 2H), 7.76 (d, J = 8 Hz, 2H), 7.59 (dt, J =1,8 Hz, 1H), 7.48 (t, J = 8 Hz, 2H), 1.37 (s, 12H). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 196.9, 139.7, 137.4, 134.5, 132.5, 130.1, 129.0, 128.3, 84.2, 24.9 (No C-B Signal). ^{1}H NMR spectrum included.

[3] Laza, C.; Duñach, E. *Adv. Synth. Catal.* **2003**, *345*, 580.
[4] Fürstner, A.; Seidel, G. *Org. Lett.* **2002**, *4*, 541.

3-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)benzonitrile (Table 1, Entry 9).[5] Following general procedure A, a mixture of 3-bromobenzonitrile (91 mg, 0.50 mmol), pinacol borane, NEt_3, $PdCl_2(CH_3CN)_2$ (1.3 mg, 0.0050 mmol) and SPhos (8.2 mg, 0.020 mmol) was heated in 1,4-dioxane for 3 h. Flash column chromatography (5% EtOAc/Hexanes) yielded the title compound in 65 mg (57% yield) as a colorless oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 8.08 (s, 1H), 7.99 (d, J = 7 Hz, 1H), 7.71 (d, J = 7 Hz, 1H), 7.46 (t, J = 7 Hz, 1H), 1.34 (s, 12H). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 138.7, 138.4, 134.4, 128.4, 118.8, 112.0, 84.4, 24.8 (No C-B Signal). ^{1}H NMR spectrum included.

2-(2-methoxyphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 10).[2] Following general procedure A, a mixture of 2-bromoanisole (62.3 μL, 93.5 mg, 0.50 mmol), pinacol borane, NEt_3, $PdCl_2(CH_3CN)_2$ (2.6 mg, 0.010 mmol) and SPhos (16.4 mg, 0.040 mmol) was heated in 1,4-dioxane for 4 h. Flash column chromatography (5% EtOAc/Hexanes) yielded the title compound in 104 mg (89% yield) as a white solid, mp 77-78 °C. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.67 (dd, J = 7,2 Hz, 1H), 7.39 (dt, J = 8,2 Hz, 1H), 6.94 (dt, J = 7,2 Hz, 1H), 6.85 (d, J = 8 Hz, 1H), 3.83 (s, 3H), 1.35 (s, 12H). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 164.8, 137.4, 133.2, 120.9, 111.1, 84.1, 56.5, 25.5 (No C-B Signal). ^{1}H NMR spectrum included.

2-(2-methoxyphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 11).[2] Following general procedure B, a mixture of 2-chloroanisole (62.3 μL, 93.5 mg, 0.50 mmol), pinacol borane, NEt_3 (0.50 mL), $PdCl_2(CH_3CN)_2$ (5.2 mg, 0.020 mmol) and SPhos (32.8 mg, 0.080 mmol) was heated for 24 h. Flash column chromatography (5.0% EtOAc/Hexanes) yielded the title compound in 60 mg (51% yield) as a white solid, mp 76-77 °C. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.67 (dd, J = 7,2 Hz, 1H), 7.39 (dt, J = 8,2 Hz, 1H), 6.94 (dt, J = 7,2 Hz, 1H), 6.85 (d, J = 8 Hz, 1H), 3.83 (s, 3H), 1.35 (s, 12H). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 164.8, 137.4, 133.2, 120.9, 111.1, 84.1, 56.5, 25.5 (No C-B Signal). ^{1}H NMR spectrum included.

2-mesityl-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 12).[6] Following general procedure A, a mixture of 2-bromomesitylene (76.5 μL, 99.5 mg, 0.50 mmol), pinacol borane, NEt_3, $PdCl_2(CH_3CN)_2$ (2.6 mg, 0.010 mmol) and SPhos (16.4 mg, 0.040

[5] Zhu, L.; Duquette, J.; Zhang, M. *J. Org. Chem.* **2003**, *68*, 3729.
[6] Ishiyama, T.; Murata, M.; Miyaura, N. *J. Org. Chem.* **1995**, *60*, 7508.

mmol) was heated in 1,4-dioxane for 4 h. Flash column chromatography (2.5% EtOAc/Hexanes) yielded the title compound in 111 mg (90% yield) as a colorless oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 6.82 (s, 2H), 2.42 (s, 6H), 2.29 (s, 3H), 1.41 (s, 12H). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 142.0, 138.8, 127.4, 83.3, 24.9, 22.1, 21.2 (No C-B Signal). ^{1}H NMR spectrum included.

(*E*)-4,4,5,5-tetramethyl-2-styryl-1,3,2-dioxaborolane (Table 1, Entry 13).[7] Following general procedure A, a mixture of β-bromostyrene (64.1 μL, 91.5 mg, 0.50 mmol), pinacol borane, NEt_3, $PdCl_2(CH_3CN)_2$ (2.6 mg, 0.010 mmol) and SPhos (16.4 mg, 0.040 mmol) was heated in 1,4-dioxane for 4 h. Flash column chromatography (2.5% EtOAc/Hexanes) yielded the title compound in 79 mg (69% yield) as a colorless oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.49 (d, J = 8 Hz, 2H), 7.41 (d, J = 18 Hz, 1H), 7.29-7.36 (m, 3H), 6.18 (d, J = 18 Hz, 1H), 1.33 (s, 12H). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 149.5, 137.4, 128.9, 128.5, 127.0, 126.5, 83.3, 24.8. ^{1}H NMR spectrum included.

1-acetyl-5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1*H*-indole (Table 1, Entry 14). Following general procedure A, a mixture of *N*-acetyl-5-bromoindole (119 mg, 0.50 mmol), pinacol borane, NEt_3, $PdCl_2(CH_3CN)_2$ (2.6 mg, 0.010 mmol) and SPhos (16.4 mg, 0.040 mmol) was heated in 1,4-dioxane for 4 h. Flash column chromatography (15% EtOAc/Hexanes) yielded the title compound in 138 mg (97% yield) as a yellow oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 8.41 (d, J = 7 Hz, 1H), 8.06 (s, 1H), 7.80 (d, J = 7 Hz, 1H), 7.40 (d, J = 2 Hz, 1H), 6.63 (d, J = 2 Hz, 1H), 2.63 (s, 3H), 1.37 (s, 12H). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 168.7, 137.4, 131.4, 129.8, 125.2, 115.8, 109.4, 83.7, 24.9, 24.1 (No C-B Signal). IR (neat, cm^{-1}): 3149, 3109, 2978, 1712, 1610, 1539, 1471, 1430, 1352, 1231, 1145. Anal. Calcd. for $C_{16}H_{20}BNO_3$: C, 67.39; H, 7.07. Found C, 67.15; H, 7.08. ^{1}H and ^{13}C NMR spectrum included.

3-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1-(triisopropylsilyl)-1*H*-pyrrole (Table 1, Entry 15).[8] Following general procedure A, a mixture of 3-bromo-1-(triisopropyl-silanyl)-1*H*-pyrrole[9] (156 mg, 0.50 mmol), pinacol borane, NEt_3, $PdCl_2(CH_3CN)_2$ (2.6 mg, 0.010 mmol) and SPhos (16.4 mg, 0.040 mmol) was heated in

[7] Pereira, S.; Srebnik, M. *Organometallics* **1995**, *14*, 3127.
[8] Billingsley, K. L.; Buchwald, S. L. *J. Am. Chem. Soc.* **2007**, *129*, 3358-3366.
[9] Alzarez, A.; Guzmen, A.; Ruiz, A.; Velards, E.; Muchowski, J. *J. Org. Chem*. **1992**, *57*, 1653-1656.

1,4-dioxane with stirring for 4 h. Flash column chromatography (15% EtOAc/Hexanes) yielded the title compound in 119 mg (74% yield) as a light yellow solid, m.p. 59 °C. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.24 (dd, J = 2,1 Hz, 1H), 6.81 (dd, J= 3,2 Hz, 1H) 6.63 (dd, J = 3,1 Hz, 1H), 7.00 (dd, J = 7,1 Hz, 1H), 1.46 (sept, J = 7 Hz, 3H), 1.33 (s, 12H), 1.09 (d, J= 7 Hz, 18H).^{13}C NMR (75 MHz, $CDCl_3$) δ: 133.6, 124.9, 115.6, 110.0, 82.6, 24.8, 17.7, 11.6. ^{1}H NMR spectrum included.

***N,N*-dimethyl-3-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)aniline (Table 1, Entry 16).[2]** Following general procedure B, a mixture of 3-chloro-*N,N*-dimethylaniline (77.8 mg, 0.50 mmol), pinacol borane, NEt_3 (0.50 mL), $PdCl_2(CH_3CN)_2$ (3.9 mg, 0.015 mmol) and SPhos (24.6 mg, 0.060 mmol) was heated with stirring for 24 h. Flash column chromatography (10% EtOAc/Hexanes) yielded the title compound in 99 mg (80% yield) as a colorless oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.27 (t, J = 8 Hz, 1H), 7.19-7.22 (m, 2H), 6.87 (dd, J = 8,3 Hz, 1H), 2.97 (s, 6H), 1.35 (s, 12 H). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 150.1, 128.5, 123.2, 118.6, 115.8, 83.6, 40.8, 24.8 (No C-B Signal). ^{1}H NMR spectrum included.

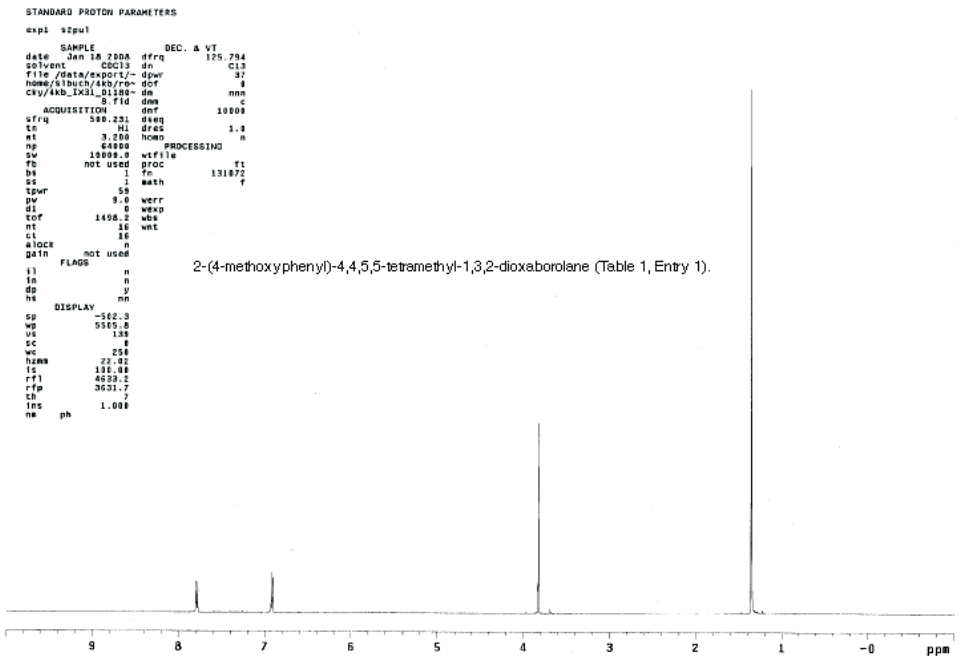
2-(2,5-dimethylphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 17).[10] Following general procedure B, a mixture of 2-chloro-*p*-xylene (67.0 μL, 70.3 mg, 0.50 mmol), pinacol borane, NEt_3 (0.50 mL), $PdCl_2(CH_3CN)_2$ (3.9 mg, 0.015 mmol) and SPhos (24.6 mg, 0.060 mmol) was heated with stirring for 24 h. Flash column chromatography (2.5% EtOAc/Hexanes) yielded the title compound in 101 mg (87% yield) as a colorless oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.60 (s, 1H), 7.15 (d, J = 8 Hz, 1H), 7.08 (d, J = 8 Hz, 1H), 2.52 (s, 3H), 2.32 (s, 3H), 1.36 (s, 12H). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 141.7, 136.3, 133.9, 131.5, 129.8, 83.3, 24.8, 21.7, 20.8 (No C-B Signal). ^{1}H NMR spectrum included.

4,4,5,5-tetramethyl-2-(thiophen-3-yl)-1,3,2-dioxaborolane (Table 1, Entry 18).[11] Following general procedure B, a mixture of 3-chlorothiophene (59.2 mg, 46.4 μL, 0.50 mmol), pinacol borane, NEt_3 (0.50 mL), $PdCl_2(CH_3CN)_2$ (3.9 mg, 0.015 mmol) and SPhos (24.6 mg, 0.060 mmol) was heated with stirring for 24 h. Flash column

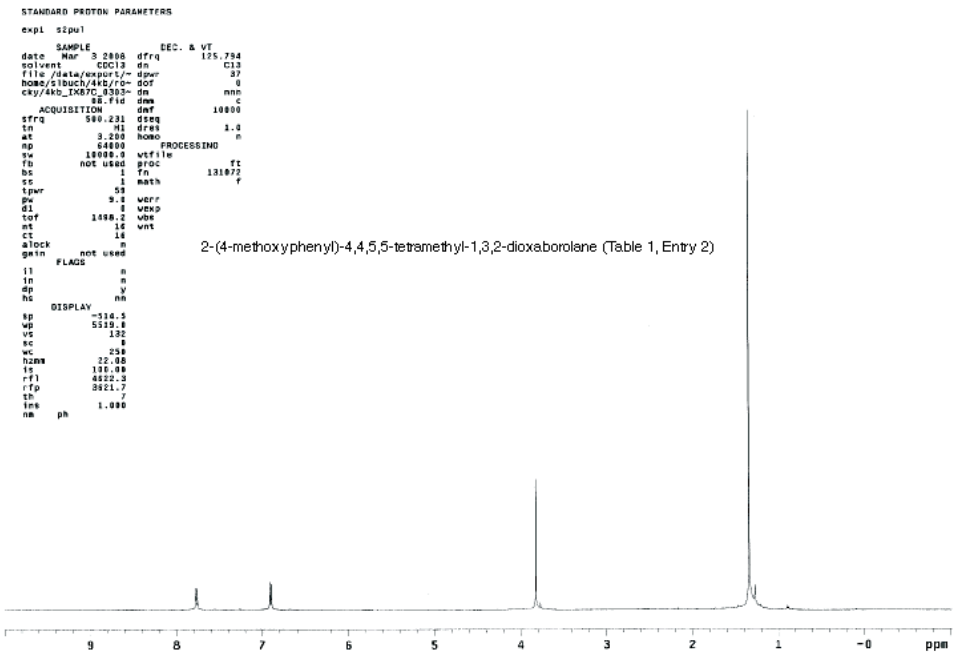
[10] Thompson, A. L. S.; Kabalka, G. W.; Akula, M. R.; Huffman, J. W. *Synthesis* **2005**, *4*, 547.
[11] Koolmeister, T.; Södergren, M.; Scobie, M. *Tetrahedron Lett.* **2002**, *43*, 5965.

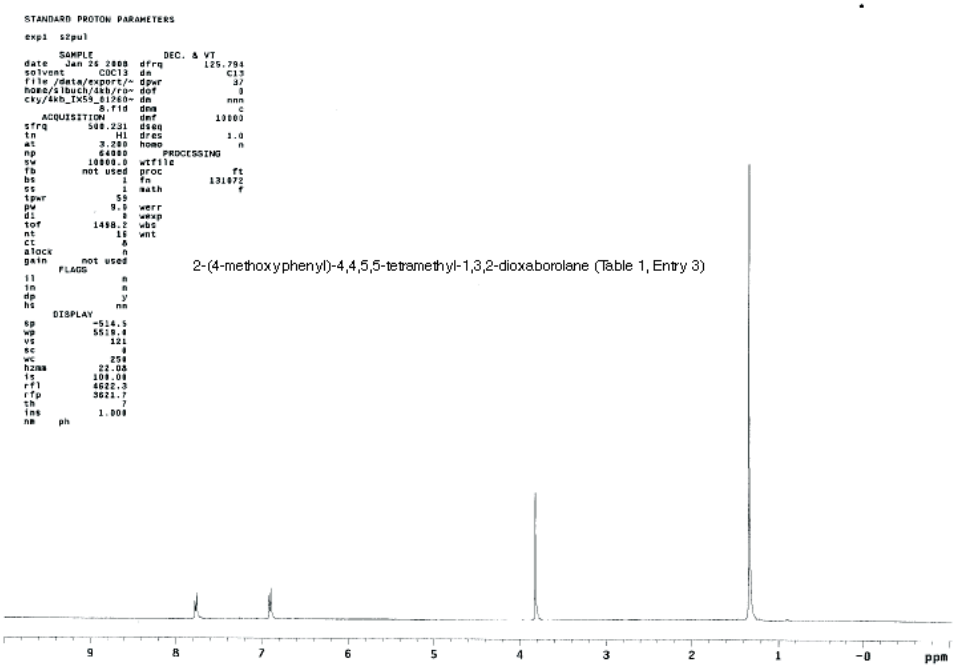
chromatography (2.5% EtOAc/Hexanes) yielded the title compound in 62 mg (59% yield) as brown solid, mp 55-56 °C. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 7.92 (dt, J = 1,3 1H), 7.41 (dt, J = 1,5 Hz, 1H), 7.34 (dt, J = 3,5 Hz, 1H), 1.33 (s, 12H). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 131.2, 132., 126.1, 103.8, 84.4, 25.6. ^{1}H NMR spectrum included.

2-cyclopentenyl-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 19).[12] Following general procedure B, a mixture of 1-chlorocyclopentene (49.6 μL, 51.3 mg, 0.50 mmol), pinacol borane, NEt_3 (0.50 mL), $PdCl_2(CH_3CN)_2$ (3.9 mg, 0.015 mmol) and SPhos (24.6 mg, 0.060 mmol) was heated with stirring for 24 h. Flash column chromatography (2.5% EtOAc/Hexanes) yielded the title compound in 71 mg (73% yield) as a colorless oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 6.54 (t, J = 2 Hz, 1H), 2.37-2.41 (m, 4H), 1.83 (pent, J = 7 Hz, 2H), 1.28 (s, 12H). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 147.6, 83.0, 34.7, 34.5, 24.8, 23.9. ^{1}H NMR spectrum included.



[12] Takagi, J.; Takahashi, K.; Ishiyama, T.; Miyaura, N. *J. Am. Chem. Soc.* **2002**, *124*, 8001.


STANDARD PROTON PARAMETERS
expl sZpul
SAMPLE
date Mar 3 2008
solvent CDCl3
file /data/export/~
home/sibuch/4kb/ro~
cky/4kb_IX67C_0303~
86.fid
ACQUISITION
sfrq 500.231
tn H1
at 3.200
np 64000
sw 10000.0
fb not used
bs 1
ss 1
tpwr 53
pw 9.0
d1 0
tof 1498.2
nt 16
ct 16
alock n
gain not used
FLAGS
il n
in n
dp y
hs nn
DISPLAY
sp -514.5
wp 5519.8
vs 132
sc 0
wc 258
hzmm 22.08
is 166.08
rfl 4622.3
rfp 3621.7
th 7
ins 1.000
nm ph
DEC. & VT
dfrq 125.784
dn C13
dpwr 37
dof 0
dm nnn
dmm c
dmf 10000
dseq
dres 1.0
homo n
PROCESSING
wtfile
proc ft
fn 131072
math f
werr
wexp
wbe
wnt
2-(4-methoxyphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 2)
9
8
7
6
5
4
3
2
1
-0
ppm

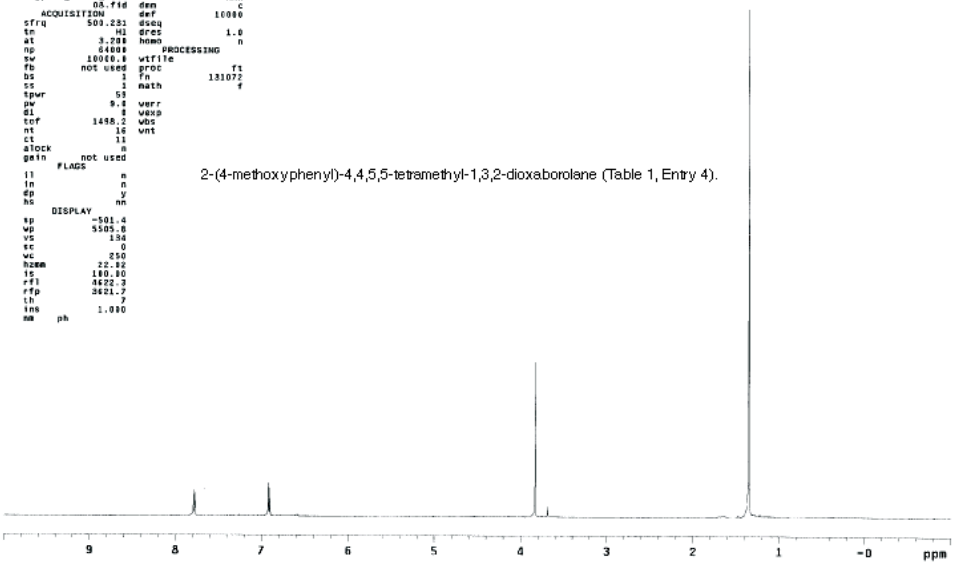

STANDARD PROTON PARAMETERS
expl sZpul
SAMPLE
date Jan 26 2008
solvent CDCl3
file /data/export/~
home/sibuch/4kb/ro~
cky/4kb_IX59_0126O~
8.fid
ACQUISITION
sfrq 500.231
tn H1
at 3.280
np 64000
sw 10000.0
fb not used
bs 1
ss 1
tpwr 59
pw 9.0
d1 0
tof 1498.2
nt 16
ct 8
alock n
gain not used
FLAGS
il n
in n
dp y
hs nn
DISPLAY
sp -514.5
wp 5519.8
vs 121
sc 0
wc 259
hzmm 22.08
is 108.08
rfl 4622.3
rfp 3621.7
th 7
ins 1.000
nm ph
DEC. & VT
dfrq 125.784
dn C13
dpwr 37
dof 0
dm nnn
dmm c
dmf 10000
dseq
dres 1.0
homo n
PROCESSING
wtfile
proc ft
fn 131072
math f
werr
wexp
wbs
wnt
2-(4-methoxyphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 3)
9
8
7
6
5
4
3
2
1
-0
ppm

STANDARD PROTON PARAMETERS

expl s2pul

SAMPLE		DEC. & VT	
date	Jan 18 2008	dfrq	125.754
solvent	CDCl3	dn	C13
file /data/export/~		dpwr	37
home/sibuch/ekb/ro~		dof	0
cky/4kb_IX40B_0118~		dm	nnn
	08.fid	dmm	c
ACQUISITION		dmf	10080
sfrq	500.231	dseq	
tn	H1	dres	1.0
at	3.208	homo	n
np	64808	PROCESSING	
sw	10080.8	wtfile	
fb	not used	proc	ft
bs	1	fn	131072
ss	1	math	f
tpwr	59		
pw	9.4	werr	
dl	8	wexp	
tof	1498.2	wbs	
nt	16	wnt	
ct	11		
alock	n		
gain	not used		
FLAGS			
il	n		
in	n		
dp	y		
hs	nn		
DISPLAY			
sp	-501.4		
wp	5505.8		
vs	184		
sc	0		
wc	250		
hzmm	22.02		
is	180.80		
rfl	4422.3		
rfp	3621.7		
th	7		
ins	1.000		
nm	ph		

2-(4-methoxyphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 4).

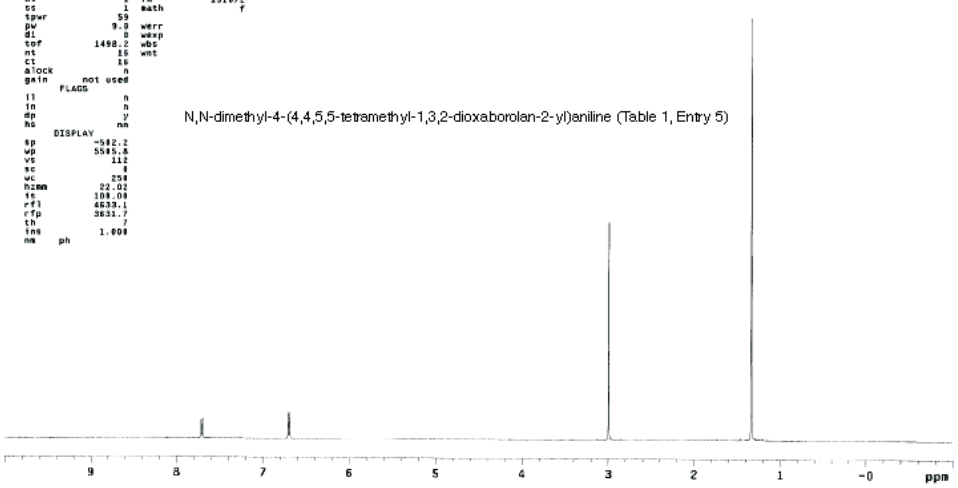


STANDARD PROTON PARAMETERS

expl s2pul

SAMPLE		DEC. & VT	
date	Jan 22 2008	dfrq	125.784
solvent	CDCl3	dn	C13
file /data/export/~		dpwr	37
home/sibuch/ekb/ro~		dof	0
cky/4kb_IX5i_0122~		dm	nnn
	8.fid	dmm	c
ACQUISITION		dmf	10080
sfrq	500.231	dseq	
tn	H1	dres	1.8
at	3.200	homo	n
np	64808	PROCESSING	
sw	10080.8	wtfile	
fb	not used	proc	ft
bs	1	fn	131072
ss	1	math	f
tpwr	59		
pw	9.0	werr	
dl	8	wexp	
tof	1498.2	wbs	
nt	16	wnt	
ct	16		
alock	n		
gain	not used		
FLAGS			
il	n		
in	n		
dp	y		
hs	nn		
DISPLAY			
sp	-582.2		
wp	5585.8		
vs	112		
sc	0		
wc	250		
hzmm	22.02		
is	108.08		
rfl	4633.1		
rfp	3631.7		
th	7		
ins	1.000		
nm	ph		

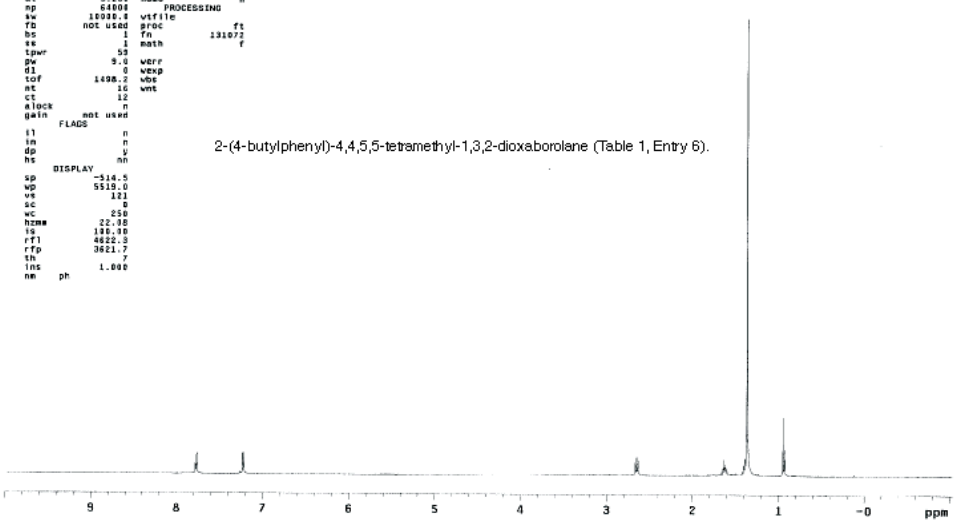
N,N-dimethyl-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)aniline (Table 1, Entry 5)



STANDARD PROTON PARAMETERS

expl s2pul

SAMPLE		DEC. & VT	
date	Jan 22 2008	dfrq	125.794
solvent	CDCl3	dn	C13
file	/data/export/~	dpwr	37
home/slbuch/4kb/ro~		dof	0
cky/4kb_IX56_31228~		dm	nnn
	8.fid	dmm	c
ACQUISITION		dmf	18000
sfrq	500.231	dseq	
tn	H1	dres	1.0
at	3.208	homo	n
np	64808	PROCESSING	
sw	18000.0	wtfile	
fb	not used	proc	ft
bs	1	fn	131072
ss	1	math	f
tpwr	59		
pw	9.0	werr	
dl	0	wexp	
tof	1498.2	wbs	
nt	16	wnt	
ct	12		
alock	n		
gain	not used		
FLAGS			
il	n		
in	n		
dp	y		
hs	nn		
DISPLAY			
sp	-514.5		
wp	5519.0		
vs	121		
sc	0		
wc	250		
hzmm	22.08		
is	180.38		
rfl	4622.3		
rfp	3621.7		
th	7		
ins	1.000		
nm	ph		

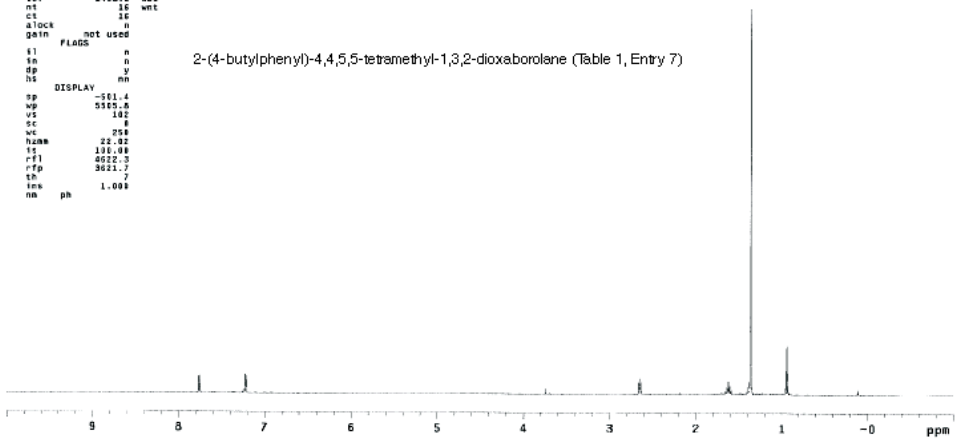


2-(4-butylphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 6).

STANDARD PROTON PARAMETERS

expl s2pul

SAMPLE		DEC. & VT	
date	Jan 18 2008	dfrq	125.794
solvent	CDCl3	dn	C13
file	/data/export/~	dpwr	37
home/slbuch/4kb/ro~		dof	0
cky/4kb_IX45_01183~		dm	nnn
	8.fid	dmm	c
ACQUISITION		dmf	19000
sfrq	500.231	dseq	
tn	H1	dres	1.0
at	3.200	homo	n
np	64808	PROCESSING	
sw	18000.0	wtfile	
fb	not used	proc	ft
bs	1	fn	131072
ss	1	math	f
tpwr	59		
pw	9.0	werr	
dl	0	wexp	
tof	1498.2	wbs	
nt	16	wnt	
ct	16		
alock	n		
gain	not used		
FLAGS			
il	n		
in	n		
dp	y		
hs	nn		
DISPLAY			
sp	-501.4		
wp	5365.6		
vs	102		
sc	0		
wc	250		
hzmm	22.02		
is	180.08		
rfl	4622.3		
rfp	3621.7		
th	7		
ins	1.000		
nm	ph		



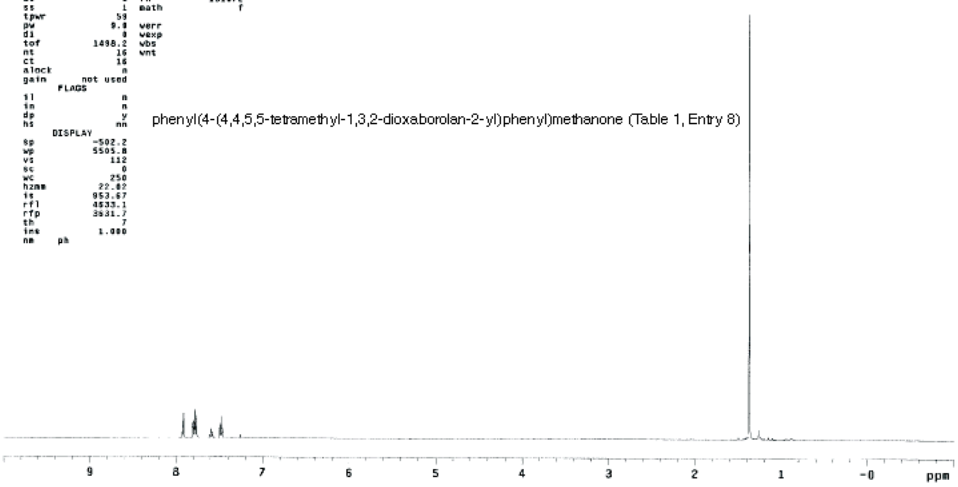
2-(4-butylphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 7)

STANDARD PROTON PARAMETERS

expl s2pul

SAMPLE		DEC. & VT	
date	Jan 22 2008	dfrq	125.794
solvent	CDCl3	dn	C13
file /data/export/~		dpwr	37
home/slbuch/4kb/ro~		dof	0
cky/4kb_IX53_01228~		da	nnn
	8.fid	dmm	c
ACQUISITION		dmf	10000
sfrq	500.231	dseq	
tn	H1	dres	1.8
at	3.208	homo	n
np	64008	PROCESSING	
sw	10080.8	wtfile	
fb	not used	proc	ft
bs	1	fn	131072
ss	1	math	f
tpwr	59		
pw	9.8	werr	
d1	0	wexp	
tof	1498.2	wbs	
nt	16	wnt	
ct	16		
alock	n		
gain	not used		
FLAGS			
il	n		
in	n		
dp	y		
hs	nn		
DISPLAY			
sp	-502.2		
wp	5505.8		
vs	112		
sc	0		
wc	250		
hzmm	22.87		
is	953.67		
rfl	4833.1		
rfp	3831.7		
th	7		
ins	1.000		
nm ph			

phenyl(4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)phenyl)methanone (Table 1, Entry 8)

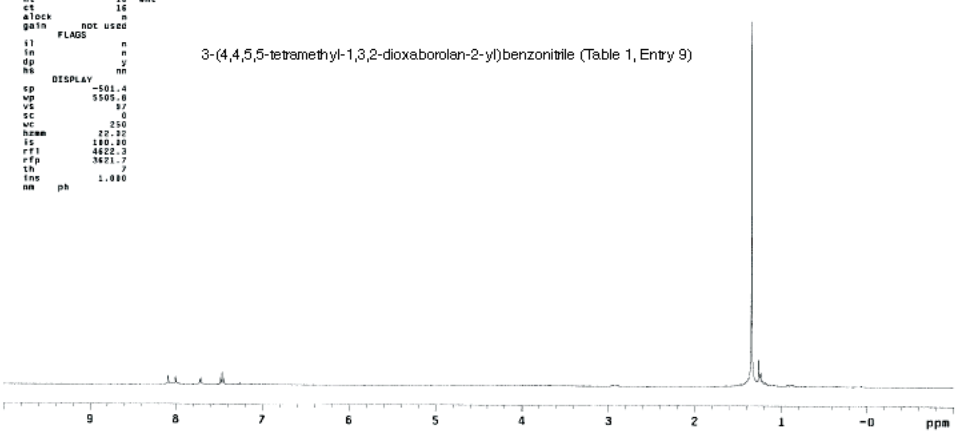


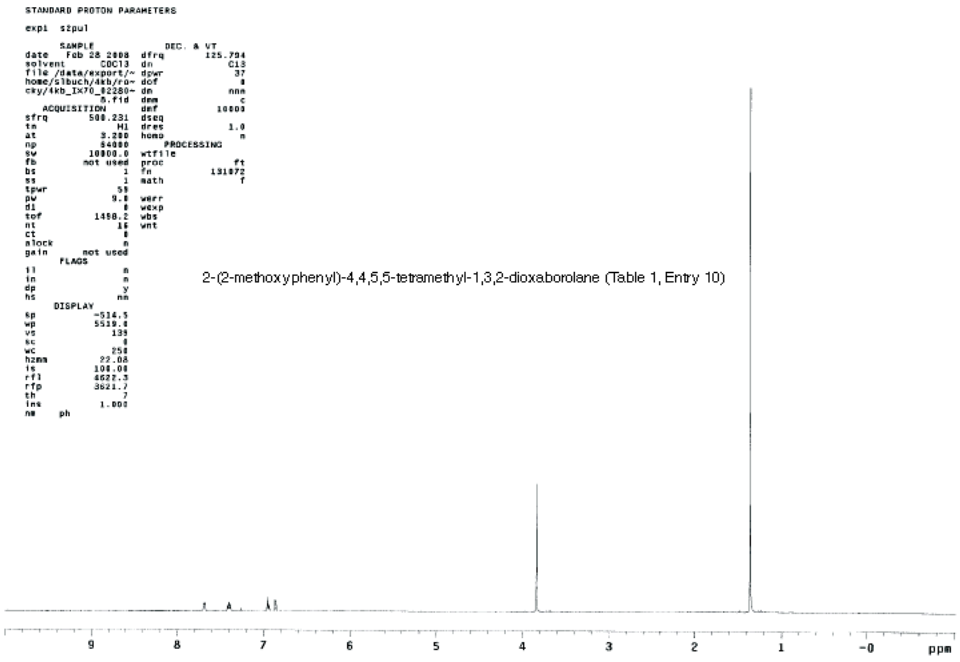
STANDARD PROTON PARAMETERS

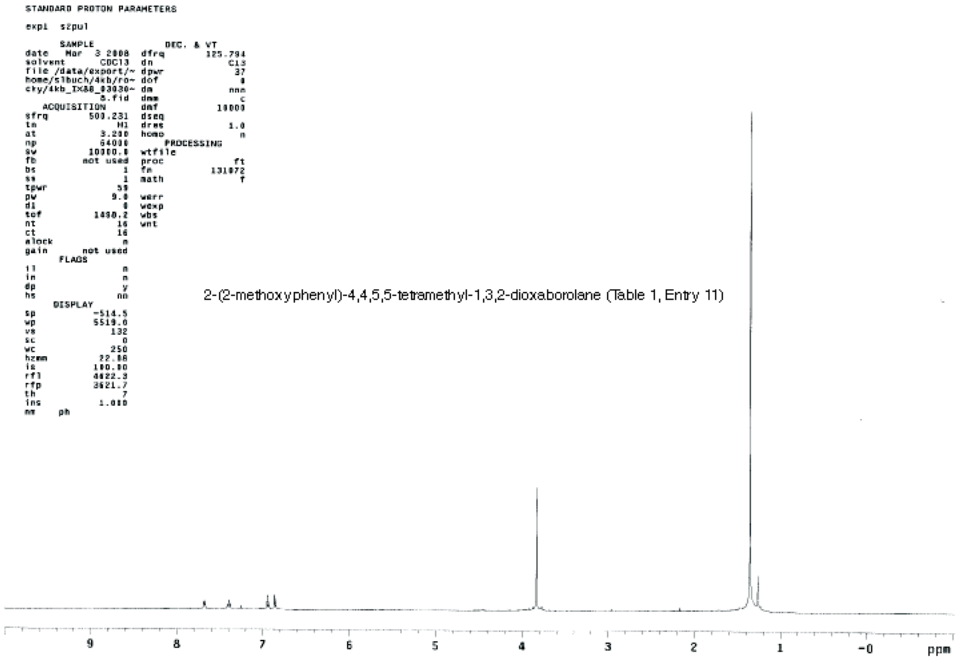
expl s2pul

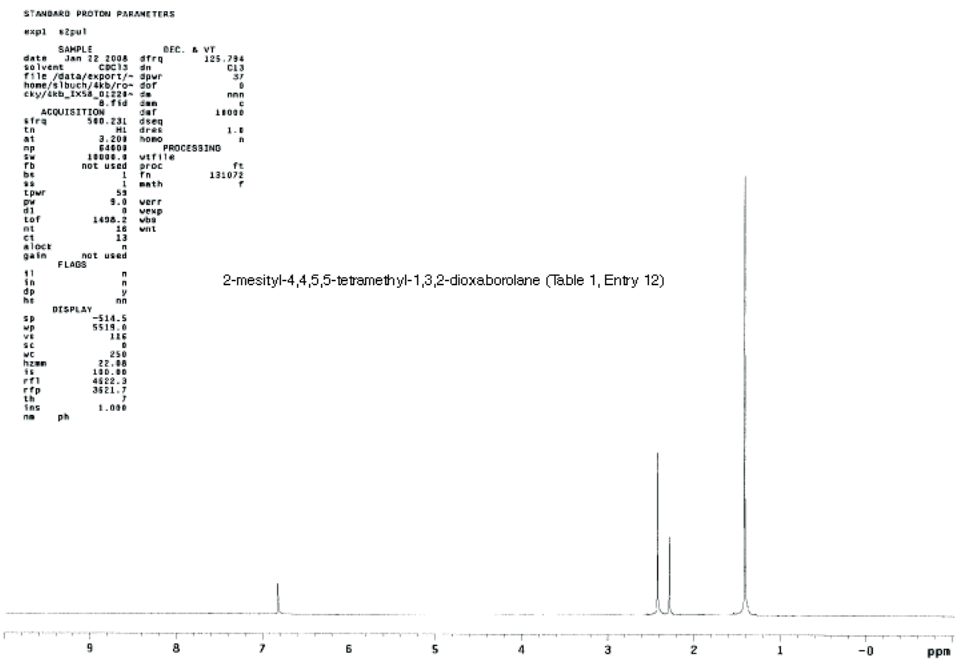
SAMPLE		DEC. & VT	
date	Jan 22 2008	dfrq	125.794
solvent	CDCl3	dn	C13
file /data/export/~		dpwr	37
home/slbuch/4kb/ro~		dof	0
cky/4kb_IX52_01225~		da	nnn
	8.fid	dmm	c
ACQUISITION		dmf	10000
sfrq	500.231	dseq	
tn	H1	dres	1.8
at	3.208	homo	n
np	64008	PROCESSING	
sw	10080.8	wtfile	
fb	not used	proc	ft
bs	1	fn	131072
ss	1	math	f
tpwr	59		
pw	9.8	werr	
d1	0	wexp	
tof	1498.2	wbs	
nt	16	wnt	
ct	16		
alock	n		
gain	not used		
FLAGS			
il	n		
in	n		
dp	y		
hs	nn		
DISPLAY			
sp	-501.4		
wp	5505.8		
vs	97		
sc	0		
wc	250		
hzmm	22.02		
is	180.20		
rfl	4622.3		
rfp	3621.7		
th	7		
ins	1.000		
nm ph			

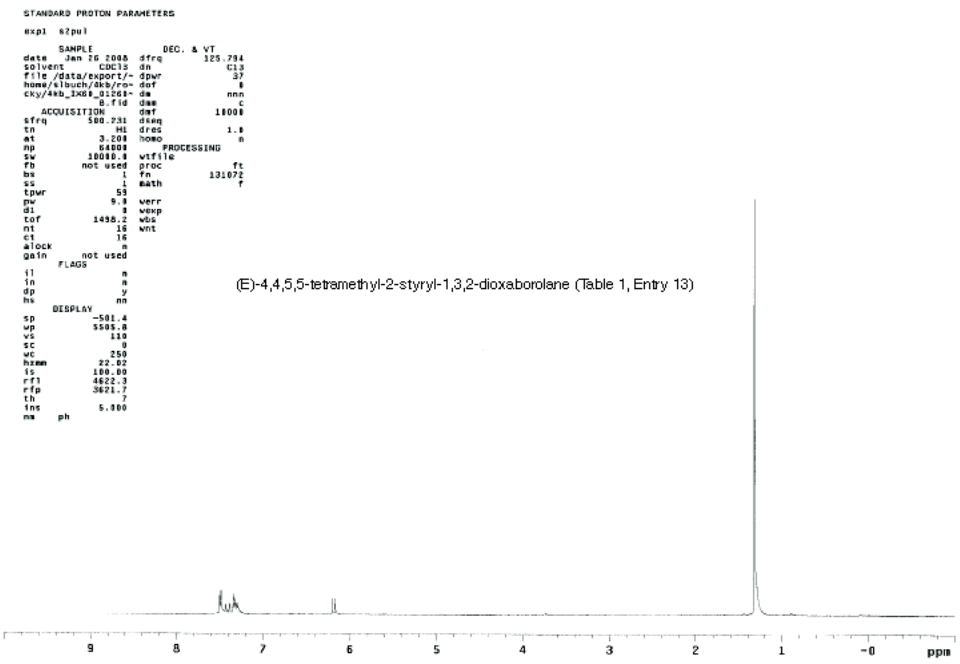
3-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)benzonitrile (Table 1, Entry 9)

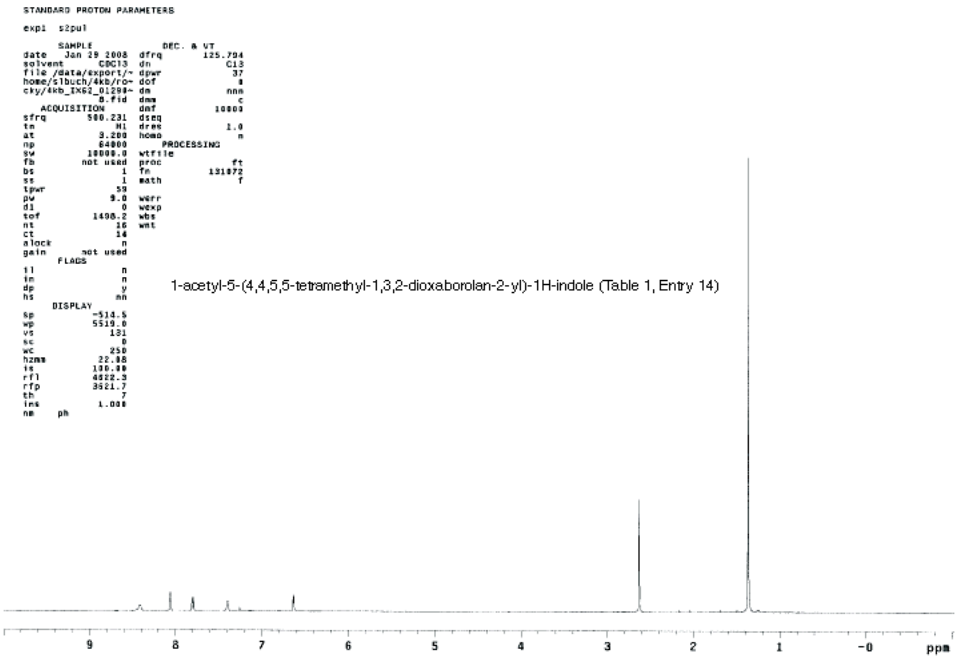


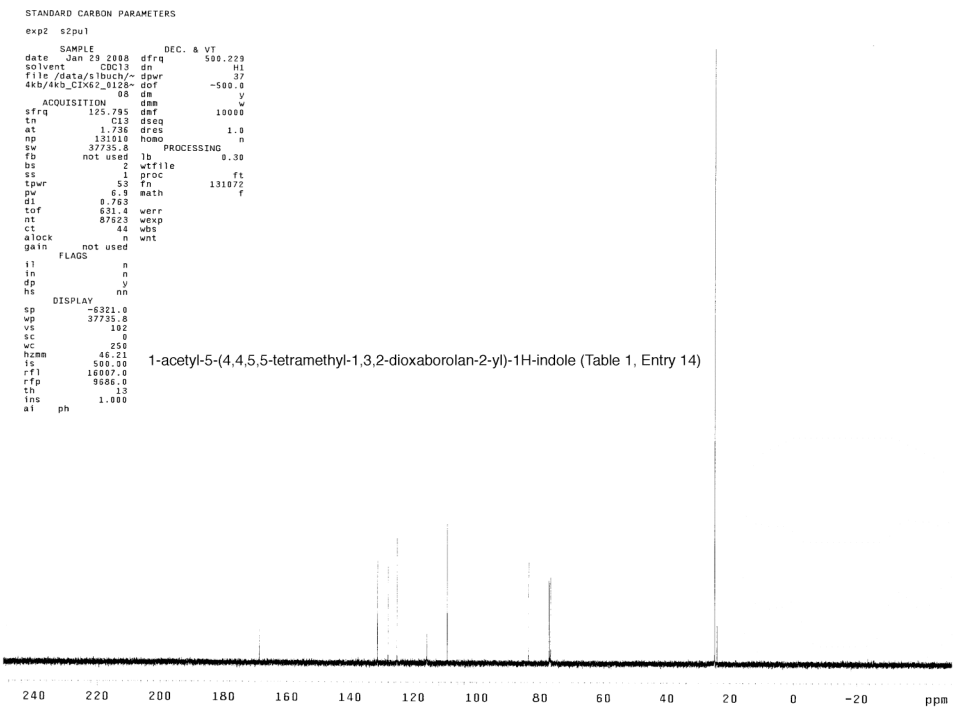

STANDARD PROTON PARAMETERS
expi szpul
SAMPLE
date Feb 28 2008
solvent CDCl3
file /data/export/~
home/slbuch/4kb/ro~
cky/4kb_IX70_82280~
5.fid
ACQUISITION
sfrq 500.231
tn H1
at 3.280
np 64000
sw 10000.0
fb not used
bs 1
ss 1
tpwr 59
pw 9.8
dl 0
tof 1498.2
nt 16
ct 0
alock n
gain not used
FLAGS
il n
in n
dp y
hs nn
DISPLAY
sp -514.5
wp 5519.6
vs 139
sc 0
wc 258
hzmm 22.08
is 108.08
rfl 4822.3
rfp 3821.7
th 7
ins 1.000
nm ph
DEC. & VT
dfrq 125.794
dn C13
dpwr 37
dof 0
dm nnn
dmm c
dmf 10000
dseq
dres 1.0
homo n
PROCESSING
wtfile
proc ft
fn 131072
math f
werr
wexp
wbs
wnt
2-(2-methoxyphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 10)
9
8
7
6
5
4
3
2
1
-0
ppm

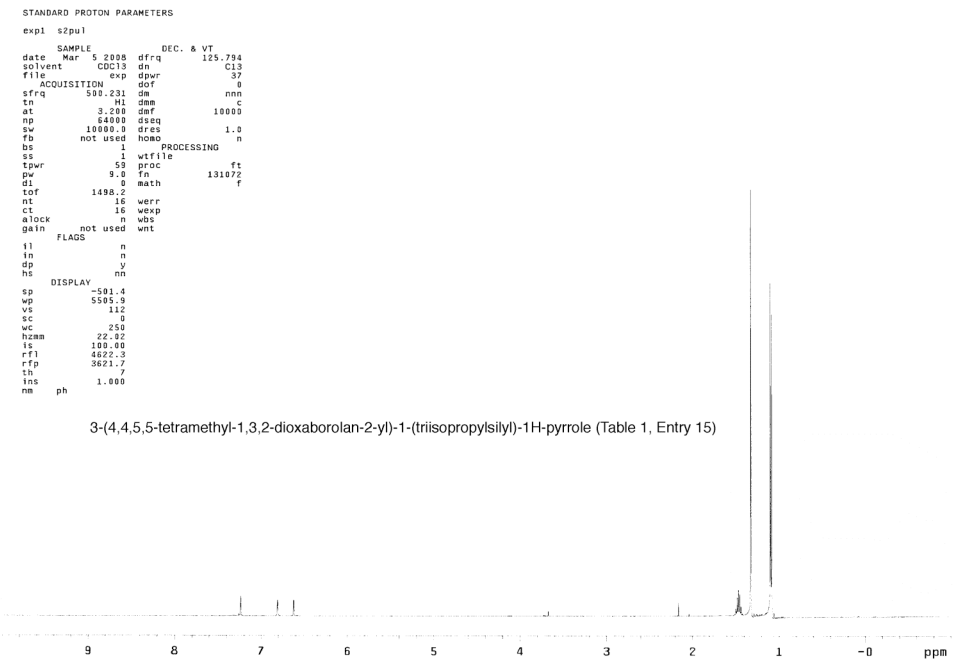

STANDARD PROTON PARAMETERS
expi szpul
SAMPLE
date Mar 3 2008
solvent CDCl3
file /data/export/~
home/slbuch/4kb/ro~
cky/4kb_IX88_83030~
5.fid
ACQUISITION
sfrq 500.231
tn H1
at 3.280
np 64000
sw 10000.0
fb not used
bs 1
ss 1
tpwr 59
pw 9.8
dl 0
tof 1498.2
nt 16
ct 16
alock n
gain not used
FLAGS
il n
in n
dp y
hs nn
DISPLAY
sp -514.5
wp 5519.0
vs 132
sc 0
wc 250
hzmm 22.08
is 180.80
rfl 4822.3
rfp 3821.7
th 7
ins 1.000
nm ph
DEC. & VT
dfrq 125.794
dn C13
dpwr 37
dof 0
dm nnn
dmm c
dmf 10000
dseq
dres 1.0
homo n
PROCESSING
wtfile
proc ft
fn 131072
math f
werr
wexp
wbs
wnt
2-(2-methoxyphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 11)
9
8
7
6
5
4
3
2
1
-0
ppm


STANDARD PROTON PARAMETERS
expl s2pul
SAMPLE
date Jan 22 2008
solvent CDCl3
file /data/export/~
home/slbuch/4kb/ro~
cky/4kb_IX58_01224~
8.fid
ACQUISITION
sfrq 500.231
tn H1
at 3.209
np 64008
sw 10000.0
fb not used
bs 1
ss 1
tpwr 59
pw 9.0
d1 0
tof 1498.2
nt 16
ct 13
alock n
gain not used
FLAGS
il n
in n
dp y
hs nn
DISPLAY
sp -514.5
wp 5519.0
vs 116
sc 0
wc 250
hzmm 22.08
is 100.00
rf1 4622.3
rfp 3621.7
th 7
ins 1.000
nm ph
DEC. & VT
dfrq 125.794
dn C13
dpwr 57
dof 0
dm nnn
dmm c
dmf 10000
dseq
dres 1.8
homo n
PROCESSING
wtfile
proc ft
fn 131072
math f
werr
wexp
wbs
wnt
2-mesityl-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 12)
9
8
7
6
5
4
3
2
1
-0
ppm

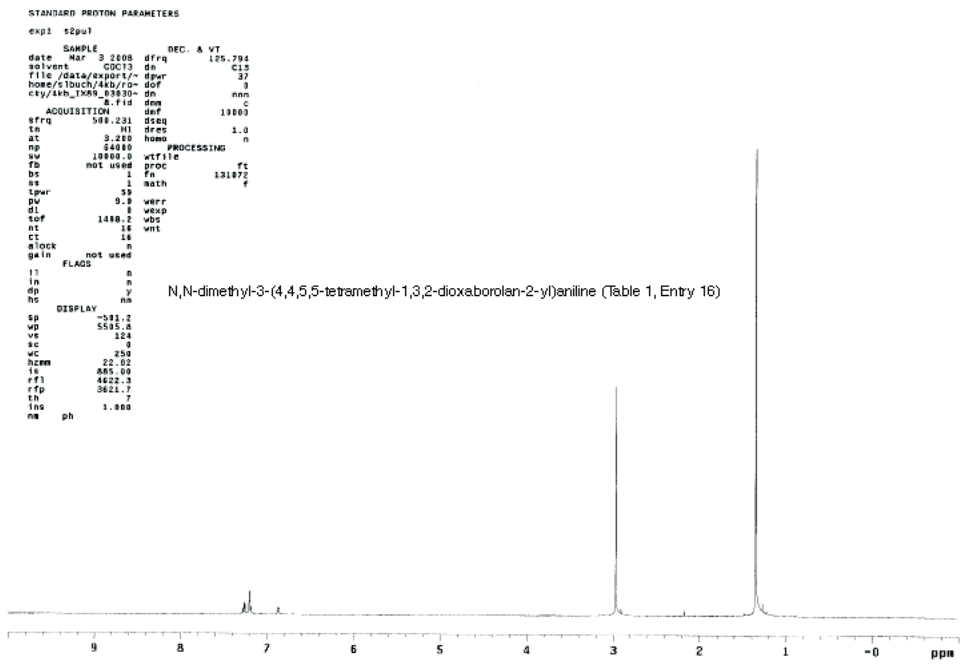

STANDARD PROTON PARAMETERS
expl s2pul
SAMPLE
date Jan 26 2008
solvent CDCl3
file /data/export/~
home/slbuch/4kb/ro~
cky/4kb_IX68_01261~
8.fid
ACQUISITION
sfrq 500.231
tn H1
at 3.208
np 64008
sw 10000.8
fb not used
bs 1
ss 1
tpwr 59
pw 9.9
d1 8
tof 1498.2
nt 16
ct 16
alock n
gain not used
FLAGS
il n
in n
dp y
hs nn
DISPLAY
sp -501.4
wp 5505.8
vs 110
sc 0
wc 250
hzmm 22.02
is 100.00
rf1 4622.3
rfp 3621.7
th 7
ins 5.000
nm ph
DEC. & VT
dfrq 125.794
dn C13
dpwr 57
dof 0
dm nnn
dmm c
dmf 10000
dseq
dres 1.8
homo n
PROCESSING
wtfile
proc ft
fn 131072
math f
werr
wexp
wbs
wnt
(E)-4,4,5,5-tetramethyl-2-styryl-1,3,2-dioxaborolane (Table 1, Entry 13)
9
8
7
6
5
4
3
2
1
-0
ppm


STANDARD PROTON PARAMETERS
expl s2pul
SAMPLE
date Jan 29 2008
solvent CDCl3
file /data/export/~
home/slbuch/4kb/ro~
cky/4kb_IX62_01284~
8.fid
ACQUISITION
sfrq 500.231
tn H1
at 3.200
np 64000
sw 10000.0
fb not used
bs 1
ss 1
tpwr 59
pw 9.0
d1 0
tof 1498.2
nt 16
ct 14
alock n
gain not used
FLAGS
il n
in n
dp y
hs nn
DISPLAY
sp -514.5
wp 5519.0
vs 131
sc 0
wc 250
hzmm 22.98
is 130.00
rfl 4822.3
rfp 3821.7
th 7
ins 1.000
ai ph
DEC. & VT
dfrq 125.794
dn C13
dpwr 37
dof 0
dm nnn
dmm c
dmf 10803
dseq
dres 1.0
homo n
PROCESSING
wtfile
proc ft
fn 131072
math f
werr
wexp
wbs
wnt
1-acetyl-5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole (Table 1, Entry 14)
9
8
7
6
5
4
3
2
1
-0
ppm

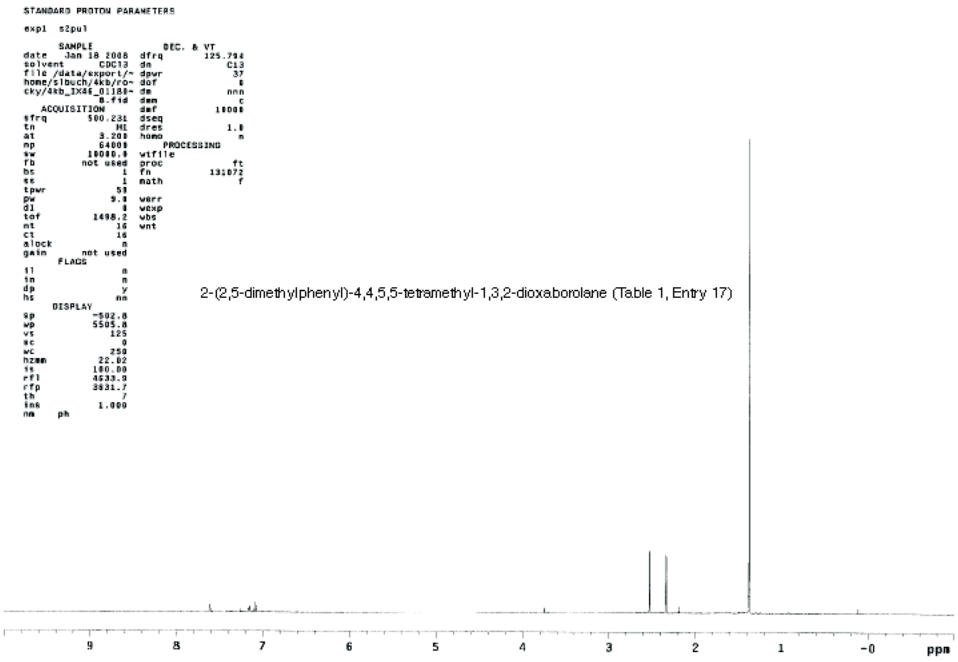

STANDARD CARBON PARAMETERS
exp2 s2pul
SAMPLE
date Jan 29 2008
solvent CDCl3
file /data/slbuch/~
4kb/4kb_CIX62_0128~
08
ACQUISITION
sfrq 125.795
tn C13
at 1.736
np 131010
sw 37735.8
fb not used
bs 2
ss 1
tpwr 53
pw 6.9
d1 0.763
tof 631.4
nt 87623
ct 44
alock n
gain not used
FLAGS
il n
in n
dp y
hs nn
DISPLAY
sp -6321.0
wp 37735.8
vs 102
sc 0
wc 250
hzmm 46.21
is 500.00
rfl 16087.0
rfp 9686.0
th 13
ins 1.000
ai ph
DEC. & VT
dfrq 500.229
dn H1
dpwr 37
dof -500.0
dm y
dmm w
dmf 10000
dseq
dres 1.0
homo n
PROCESSING
lb 0.30
wtfile
proc ft
fn 131072
math f
werr
wexp
wbs
wnt
1-acetyl-5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole (Table 1, Entry 14)
240
220
200
180
160
140
120
100
80
60
40
20
0
-20
ppm

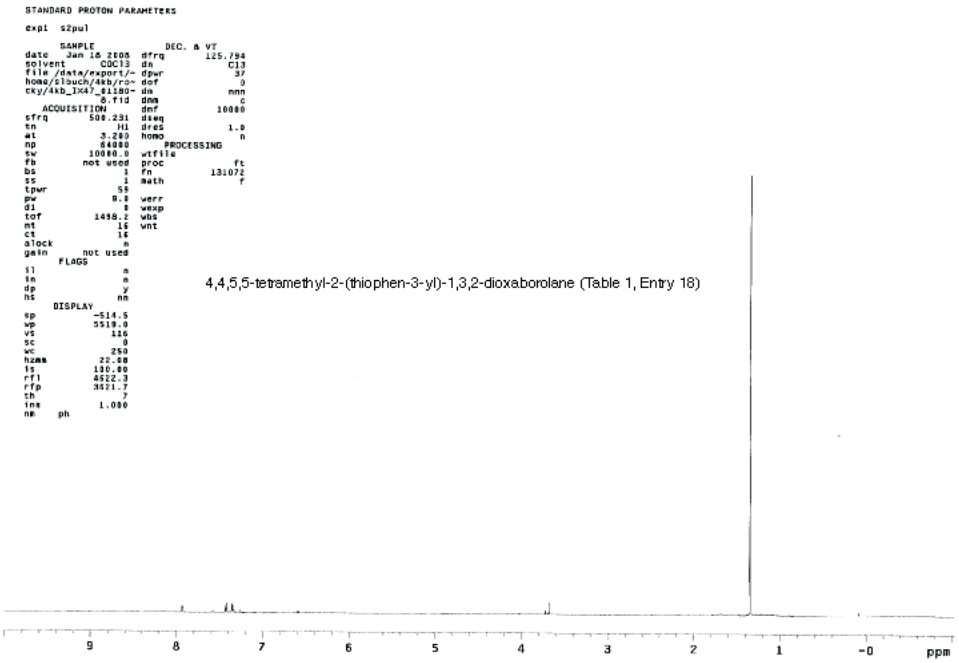


3-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1-(triisopropylsilyl)-1H-pyrrole (Table 1, Entry 15)



N,N-dimethyl-3-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)aniline (Table 1, Entry 16)

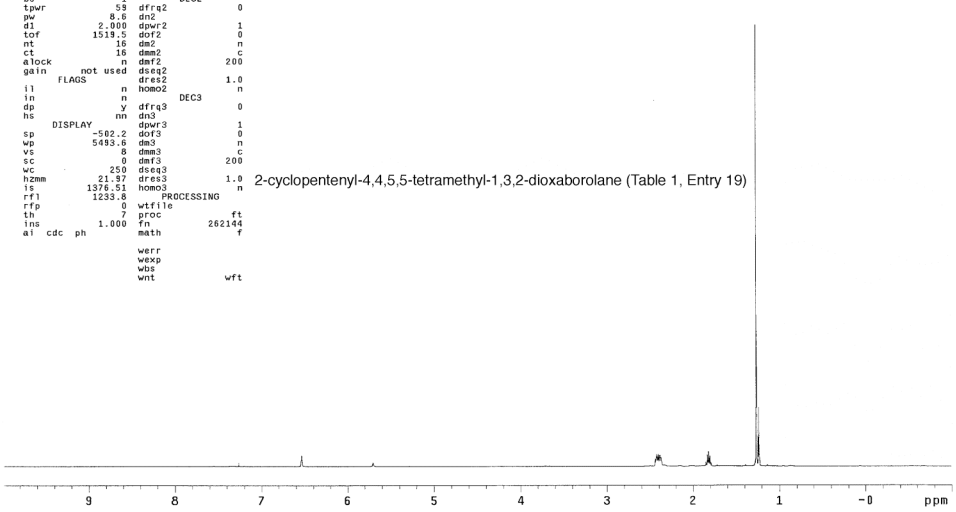

STANDARD PROTON PARAMETERS
expl s2pul
SAMPLE
date Jan 18 2008
solvent CDCl3
file /data/export/~
home/slbuch/4kb/ro~
cky/4kb_IX46_01181~
8.fid
ACQUISITION
sfrq 500.231
tn H1
at 3.28
np 64808
sw 10080.9
fb not used
bs 1
ss 1
tpwr 59
pw 9.8
d1 8
tof 1498.2
nt 16
ct 16
alock n
gain not used
FLAGS
il n
in n
dp y
hs nn
DISPLAY
sp -502.8
wp 5505.8
vs 125
sc 0
wc 250
hzmm 22.82
is 180.00
rfl 4533.9
rfp 3831.7
th 7
ins 1.000
nm ph
DEC. & VT
dfrq 125.794
dn C13
dpwr 37
dof 0
dm nnn
dmm c
def 10080
dseq
dres 1.0
homo n
PROCESSING
wtfile
proc ft
fn 131072
math f
werr
wexp
wbs
wnt
2-(2,5-dimethylphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 17)
9
8
7
6
5
4
3
2
1
-0
ppm


STANDARD PROTON PARAMETERS
expl s2pul
SAMPLE
date Jan 18 2008
solvent CDCl3
file /data/export/~
home/slbuch/4kb/ro~
cky/4kb_IX47_01180~
8.fid
ACQUISITION
sfrq 500.231
tn H1
at 3.280
np 64808
sw 10080.9
fb not used
bs 1
ss 1
tpwr 59
pw 9.8
d1 8
tof 1498.2
nt 16
ct 16
alock n
gain not used
FLAGS
il n
in n
dp y
hs nn
DISPLAY
sp -514.5
wp 5518.0
vs 116
sc 0
wc 250
hzmm 22.88
is 180.00
rfl 4522.3
rfp 3821.7
th 7
ins 1.000
nm ph
DEC. & VT
dfrq 125.794
dn C13
dpwr 37
dof 0
dm nnn
dmm c
dmf 10080
dseq
dres 1.0
homo n
PROCESSING
wtfile
proc ft
fn 131072
math f
werr
wexp
wbs
wnt
4,4,5,5-tetramethyl-2-(thiophen-3-yl)-1,3,2-dioxaborolane (Table 1, Entry 18)
9
8
7
6
5
4
3
2
1
-0
ppm

STANDARD PROTON PARAMETERS

expl s2pul

SAMPLE		DEC. & VT	
date	Mar 6 2008	dfrq	125.672
solvent	CDCl3	dn	C13
file	exp	dpwr	30
ACQUISITION		dof	0
sfrq	499.746	dm	nnn
tn	H1	dmm	w
at	3.001	dmf	10000
np	63050	dseq	
sw	10504.2	dres	1.0
fb	not used	homo	n
bs	1	DEC2	
tpwr	58	dfrq2	0
pw	8.6	dn2	
d1	2.000	dpwr2	1
tof	1519.5	dof2	0
nt	16	dm2	n
ct	16	dmm2	c
alock	n	dmf2	200
gain	not used	dseq2	
FLAGS		dres2	1.0
il	n	homo2	n
in	n	DEC3	
dp	y	dfrq3	0
hs	nn	dn3	
DISPLAY		dpwr3	1
sp	-502.2	dof3	0
wp	5493.6	dm3	n
vs	8	dmm3	c
sc	0	dmf3	200
wc	250	dseq3	
hzmm	21.97	dres3	1.0
is	1376.51	homo3	n
rfl	1233.8	PROCESSING	
rfp	0	wtfile	
th	7	proc	ft
ins	1.000	fn	262144
ai cdc ph		math	f
		werr	
		wexp	
		wbs	
		wnt	wft



2-cyclopentenyl-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (Table 1, Entry 19)